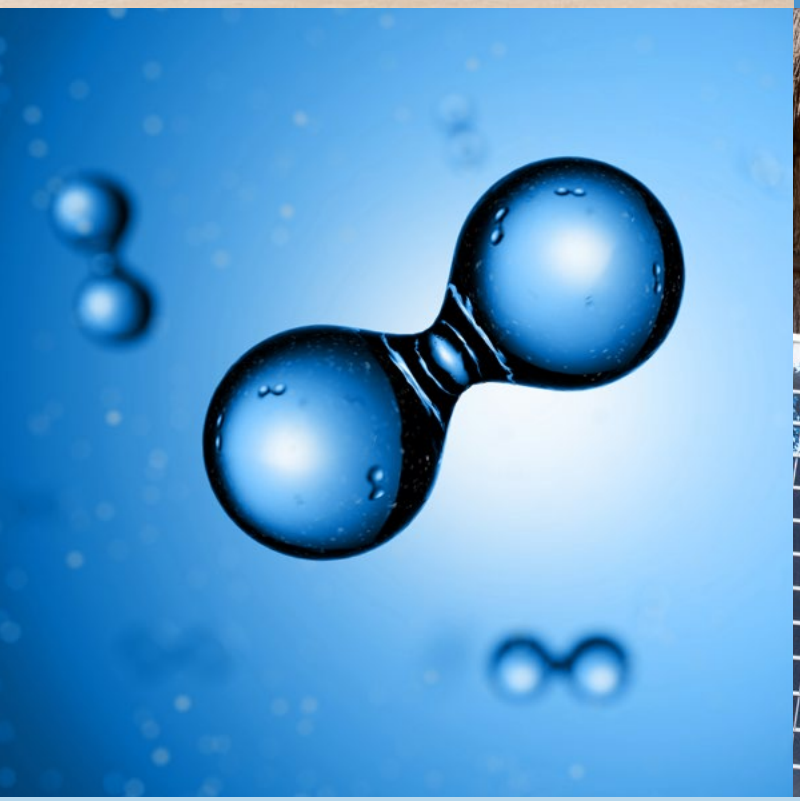
World Future Council

Brot für die Welt

POLICY BRIEF

REGULATING THE H_2YPE: RENEWABLE HYDROGEN IN THE GLOBAL SOUTH



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Authors:
Anna Skowron, World Future Council
Dr. Joachim Fünfgelt, Brot für die Welt

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Gwamaka Kifukwe, REN21
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World Future Council
Große Elbstr. 117
22767 Hamburg
Germany
www.worldfuturecouncil.org

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CLIMATE ACTION AND RENEWABLE HYDROGEN

In order to limit global warming to 1.5°C as required under the Paris Agreement, all sectors of the economy need to decarbonise.[1,2] This requires countries to become much more energy efficient and to minimise fossil fuel intensive practices (e.g. meat consumption, short distance flights) and affluent countries to also drastically reduce energy consumption. Most sectors such as private and public transport, industrial heating processes, residential heating, etc. can be decarbonised through direct electrification powered by renewable energy (RE). Moving towards such an electricity economy requires us to accelerate RE deployment much faster to ensure rapid decarbonisation in line with the Paris Agreement. Some sectors, however, cannot be easily electrified, because they require higher energy density (e.g. steel, aluminium, cement, chemical industries, aviation, shipping). For those (end-use) sectors, renewable hydrogen (green) can be a solution to achieve deep decarbonisation.

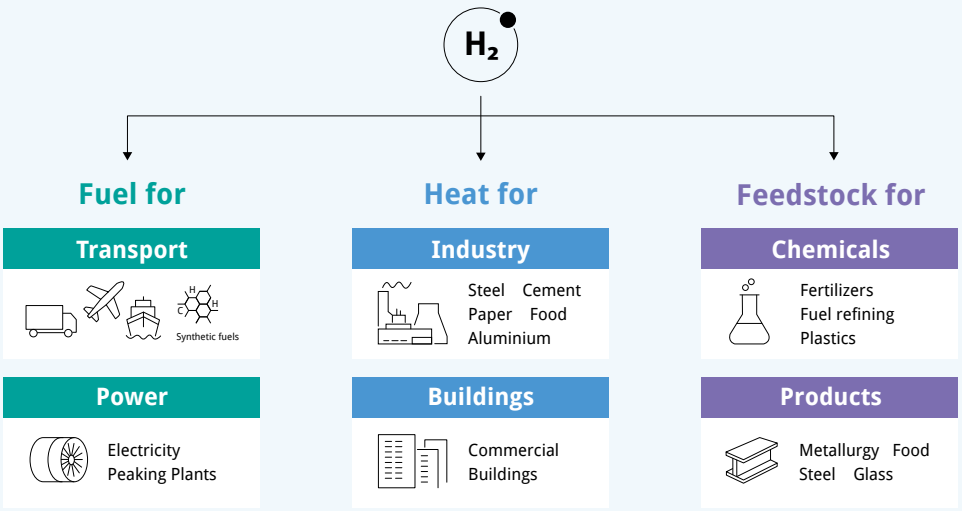
WHAT IS RENEWABLE HYDROGEN

Renewable hydrogen – often referred to as "green" hydrogen – is produced solely from renewable energy (RE) and therefore is the only suitable form of hydrogen for a sustainable energy transition and decarbonisation. Green hydrogen is produced by using electrolysis to split water molecules.

With only about 0,02% of global pure hydrogen production stemming from RE, the industry is still in its infancy stage (IRENA 2020). Yet, it has the potential to decarbonise energy intensive sectors such as aviation and manufacturing, synthetic fuel production and others. In addition, renewable hydrogen can increase system flexibility and storage options which support further uptake of variable RE.

To ensure a rapid, complete decarbonisation, enabling policies, much faster renewable energy deployment, strict sustainability standards and large investments in renewable hydrogen will be needed to accelerate market uptake and drive integration.

THE MANY USES OF HYDROGEN



Adapted from: BloombergNEF

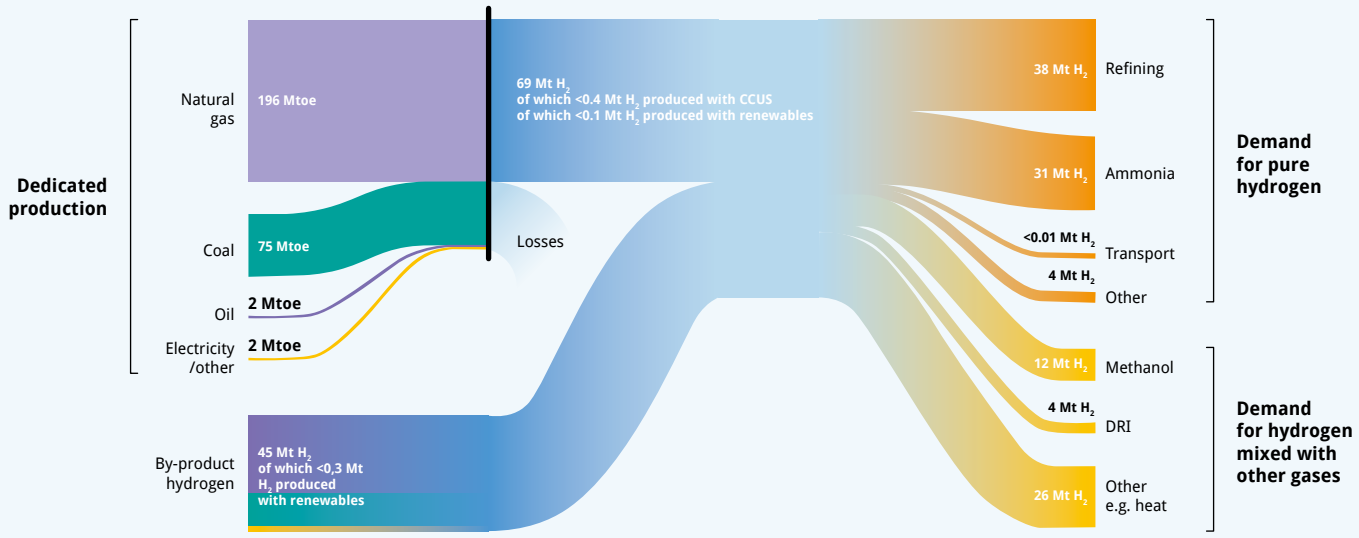
The role of hydrogen in national, regional and global energy transition scenarios varies widely. As a rule of thumb, the greater the emission reduction target across sectors, the bigger a role for hydrogen. Currently, around 120 million tonnes are produced globally each year[3] and are expected to increase significantly with additional hydrogen strategies put forward as part of economic recovery efforts from COVID-19. Fossil hydrogen production accounts for about 830 million tonnes of carbon dioxide emissions per year (2.2% of the world's total emissions),[4] almost 100 million tonnes more than Germany emitted in 2020.[5] All fossil ways to produce hydrogen, with or without Carbon Capture and Storage, therefore continue to create demand for an industry on its way out and put an additional burden on people and planet.

Despite being a growing industry and achieving a significant cost reduction of 60% since 2010 (USD$ 4-6/kg), the price for renewable hydrogen production is still 2 to 3 times higher than for other shades of hydrogen produced from fossil fuels.[6]

To date, no significant renewables-based hydrogen production is in place. With the largest plant being inaugurated in January 2021 in Canada, with a capacity of 20 MW, [7] the utilisation has so far been very limited. The installation is expected to produce 3,000 tonnes of renewable hydrogen per year. Current hydrogen strategies are nevertheless slowly taking up renewable hydrogen as long-term investment to reduce greenhouse gas emissions and massive upscaling of projects can be expected, as part of countries' post-COVID-19 recovery measures.

Demand for hydrogen needs to be kept low, while renewable hydrogen production is scaled up. Otherwise, we risk creating continued demand for fossil hydrogen. Therefore, electrification and, particularly for the Global North, reduction in total energy demand will have to be prioritised, while fossil hydrogen capacities are being replaced by renewable hydrogen capacities.

1 Teske et al. (2019); Achieving the Paris Climate Agreement Goals, Sven Teske Editor, Global and Regional 100% Renewable Energy Scenarios with Non-energy GHG Pathways for +1.5 °C and +2 °C: Chapter 5, https://rd.springer.com/book/10.1007%2F978-3-030-05843-2#about [last accessed 10 September 2021].
2 Due to the fact some synthetic fuels still need carbon, the term defossilisation is increasingly used. In respective processes, CO2 from direct air capture (DAC) is added to hydrogen.
3 IRENA, 2019a.
4 IEA 2020: https://www.iea.org/fuels-and-technologies/hydrogen [last accessed 10 September 2021].
5 UBA 2021: https://www.umweltbundesamt.de/presse/pressemitteilungen/treibhausgasemissionen-sinken-2020-um-87-prozent [last accessed 10 September 2021].
6 IRENA 2021: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENA_Green_Hydrogen_breakthrough_2021.pdf [last accessed 10 September 2021].
7 https://www.rechargenews.com/transition/worlds-largest-green-hydrogen-plant-inaugurated-in-canada-by-air-liquide/2-1-952085 [last accessed 10 September 2021].



Source: International Energy Agency, Morgan Stanley

RENEWABLE HYDROGEN IN THE GLOBAL SOUTH

Following strong signals of major economies like Germany, the US, France, Japan, China and others to invest into renewable hydrogen production nationally and abroad, renewable hydrogen production and trade is expected to increase significantly. In fact, until June 2021, plans for more than 200 GW of additional renewable hydrogen have been published.[8] Amongst them projects in Mauritania, Chile, and Brazil. Yet, hydrogen, and even less so renewable hydrogen, have not been playing a major role in most countries in the Global South. Between 2018 and 2020, Chile was the only Global South country to stipulate a hydrogen strategy, with South Africa pioneering the development in 2008 already. Other countries such as Morocco, Uruguay, and others are expected to follow soon.

To ensure hydrogen production does not further accelerate the climate crisis and countries won't be locked in a fossil fuel pathway for decades, hydrogen strategies need to focus on renewable hydrogen production. It is imperative to point out that only the production of renewable hydrogen can unleash the countries' development potential sustainably. By increasing renewable energy capacities for the hydrogen economy, countries could leapfrog into the renewable energy age, enhance climate action, strengthen local value creation and increase job opportunities for local communities.[9] In addition, local production and use of renewable hydrogen could fast-track access to energy services, further contributing to economic development, as compared to exporting renewable hydrogen which would reduce locally available energy resources.

However, even the production of renewable hydrogen and its derived Power-to-X[10] products such as Ammonia brings certain risks which need to be curtailed. Amongst others, RE capacities have to foremost replace fossil fuel capacities before being used to produce hydrogen. If this is not the case, countries risk being locked in a fossil fuel pathway. This would ultimately not contribute to the necessary (global) emission reduction, if we are to stop the climate crisis. In addition, production without proper social and environmental impact assessments and strict sustainability standards might lead to land-use conflicts, while production from large hydropower might increase instances of forced re-settlement. Therefore, inclusion of local communities must be a requirement for hydrogen production and its derivates. Further, to unleash the development potential of hydrogen, its local production and use has to be prioritised and planned for, for instance through local content policies or financial assistance for feasibility studies and project siting. If an export-oriented hydrogen production is established, countries risk prolongation of energy poverty,[11] as needed energy resources are used to satisfy international hydrogen demand rather than securing stable energy supply for local communities. With Germany and other European states particularly looking towards establishing hydrogen production in African countries for cheap imports, based on the continent's abundant RE resources, they risk bypassing international responsibilities and prolong energy poverty. This approach might in part be driven by a lack of political will to harness Europe's full RE potential and the needed structural transformation.

Further, countries would risk dependence on large financiers as well as economic losses associated with high costs for long distance transport which would be required in most cases. Depending on the production site, transport modes and costs can have a significant impact on financial viability and environmental feasibility of hydrogen production. Generally speaking, countries with high wind energy potentials, combined with good PV availability have comparatively lower production prices than countries without sufficient wind energy resources, according to the H2 Atlas by Fraunhofer Institute.[12]

8 https://www.rechargenews.com/energy-transition/global-green-hydrogen-pipeline-exceeds-200gw-heres-the-24-largest-gigawatt-scale-projects/2-1-933755 [last accessed 10 September 2021]

9 IRENA Coalition for Action (2021), Decarbonising end-use sectors: Practical insights on green hydrogen, International Renewable Energy Agency, Abu Dhabi. Available at: https://coalition.irena.org/-/media/Files/IRENA/Agency/Publication/2021/May/IRENA_Coalition_Green_Hydrogen_2021.pdf [last accessed 5 August 2021].

10 Power-to-X (PtX) refers to conversation of electricity "to make almost any product traditionally based on fossil fuels [...] and is particularly useful for applications that cannot directly use renewable electricity." (International PtX Hub, 2021).

11 Energy poverty can be defined as communities and/or households who experience inadequate energy supply and, as a consequence, are not able to meet essential energy services (e.g. cooling, heating, lighting). Some of the reasons for energy poverty can be high energy expenditure, low incomes, insufficient grid connectivity and energy access.

12 Fraunhofer IEE (2021): Neuer Atlas zeigt erstmals die weltweiten Power-to-X-Potenziale. Available at https://www.iee.fraunhofer.de/de/presse-infothek/Presse-Medien/Pressemitteilungen/2021/neuer-atlas-power-to-x-potenziale.html [last accessed 05 August 2021].

RISKS AND OPPORTUNITIES OF HYDROGEN PRODUCTION IN THE GLOBAL SOUTH

STRENGTH

- Use of abundantly available local energy resources (solar, wind)
- Young and growing population for employment
- Land availability

WEAKNESSES

- Political instability and weak institutions
- Low investment capacity and high upfront costs
- High legal and political uncertainty
- Lack of required infrastructure
- Long distance transport required and associated high costs

OPPORTUNITIES

- Fast-tracked access to energy services
- Enhanced access to education and training
- Local and national value creation through new value chains and jobs, local manufacturing of components and industrial products
- Increased energy security through strengthened independence from fossil fuel imports
- Accelerated deployment of renewable energies
- Meeting local hydrogen demand for local industry and seasonal storage

THREATS & RISKS

- Prolongation of fossil fuel structures and power plants
- Land use conflicts
- Water scarcity and conflicting water use priorities
- Potential negative impacts on local ecosystems
- Lack of social acceptance and inclusion of local population in decision making
- Technology failures
- Financial dependence on donor countries
- Energy poverty

KEY POLITICAL QUESTIONS

How can renewable energy capacities be scaled up to enable the production of hydrogen from renewable energy-powered electrolysis?

Almost 10,000GW of electrolysis capacities will be required by 2050, if we are to limit global warming to 1.5°C.[13] This will require immense scale up of RE capacities in hydrogen producing countries both large-scale and small-scale.

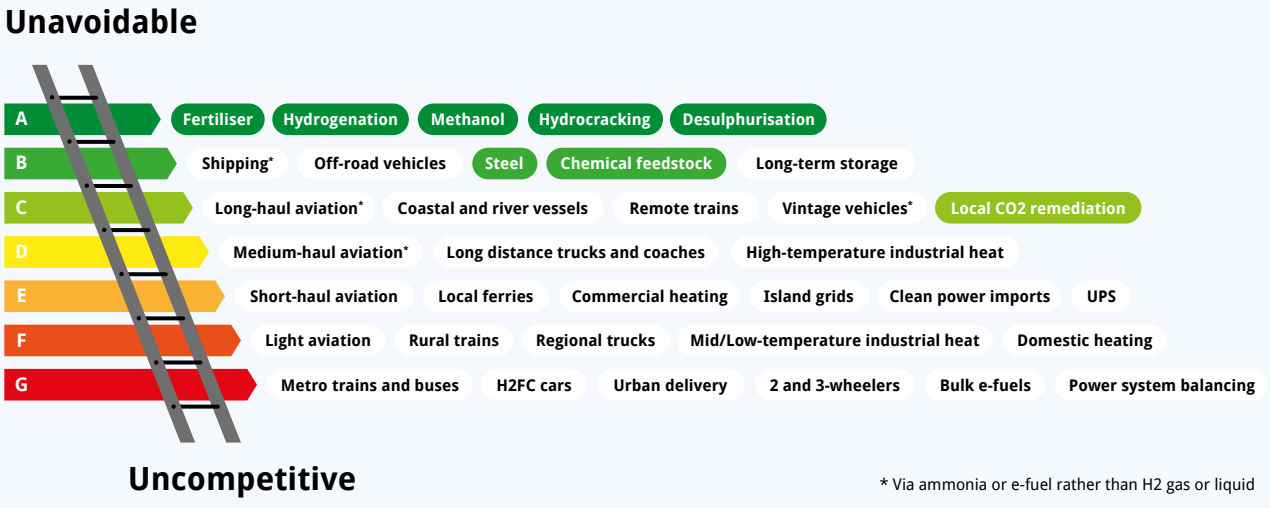
How can we ensure hydrogen applications are limited to hard-to-electrify sectors?

Limiting hydrogen use to sectors without decarbonisation alternatives will be crucial to ensure the "greenness" along the entire hydrogen value chain. To do so, governments need to set quantified targets, based on hydrogen demand of sectors with a certain energy density (e.g. aluminium, steel production, aviation). Hydrogen application and investments in infrastructure for sectors which can already be electrified (e.g. private transport) or in the near future should not be considered.

How can we guarantee that exported green hydrogen and its derived PtX products meet broad social and sustainability criteria?[14]

Albeit green hydrogen is produced using solely renewable energy, sustainability of production needs to be ensured. This includes setting up a broad set of social and sustainability standards ensuring hydrogen production in the Global South does not negatively impact livelihoods of local communities, local ecosystems as well as a guarantee of origin scheme for trading and export.

HYDROGEN: THE LADDER



* Via ammonia or e-fuel rather than H2 gas or liquid

Source: Liebreich Associates /concept credit: Adrian Hiel/Energy Cities

How can hydrogen production add local value and improve livelihoods of local communities in the Global South?

Producing hydrogen in countries in the Global South can open up new development trajectories and satisfy local demand for hydrogen (e.g. local industry, aviation). By increasing RE capacities to scale up hydrogen production and utilising a certain share for the local population can speed up energy access and facilitate access to basic energy services for the local economy.

What is the readiness of countries in the Global South to produce renewable hydrogen?

According to Frauenhofer IEE's PtX-Atlas,[15] the readiness of countries to produce renewable hydrogen depends on a couple of factors, such as availability of freshwater and RE resources, technical as well as socio-economic factors. Generally, localities with good wind resources in combination with solar PV are able to produce hydrogen at less costs than those without good wind resources. In addition, the proximity between the producing and importing country plays a role in reducing transport costs. With longer distance, (environmental) costs associated with transport tend to increase, making hydrogen export often unfeasible. However, hydrogen derivates are easier to transport and typically add local value in the exporting country, so global import/export might be considered. Further, readiness for hydrogen implementation should be based on a set of socio-economic indicators, such as political stability, unemployment, energy demand and status of electrification, civil society participation, economic and development targets as well as investment needs for storage or infrastructure. The lower socio-economic indicators are, the higher the (perceived) risks associated with hydrogen production. This in turn leads to higher investment needs and upfront capital.

How can governments in the Global South and donor countries ensure a fair distribution of wealth and income from energy projects in a hydrogen economy?

Especially in countries where hydrogen is being promoted in partnership with overseas development assistance by e.g. Germany, benefits for local development must be harnessed and eco-systems protected, in order to avoid being regarded as exploitation to the detriment of the renewable energy transition. This should be done by embedding a set of robust sustainability and social criteria for project siting and installation, supply chains, public participation, additionality and fair investment practices.

How can green hydrogen contribute to achieving the sustainable development goals and Paris Agreement's climate limits?

As a prerequisite for renewable hydrogen strategies to support implementation of the Paris Agreement and Agenda 2030, national 100% Renewable Energy strategies need to be developed which calculate demand, potentials and identifies production locations. Hydrogen strategies must be firmly embedded into those national energy strategies, the country's respective NDCs as well as development plans of the producing country. Doing so ensures conflicts of goals and resources can be avoided. In addition, criteria must be put in place to ensure success of local transformation pathways.

13 Ram M., Bogdanov D., Aghahosseini A., Gulagi A., Oyewo A.S., Child M., Caldera U., Sadovskaia K., Farfan J., Barbosa LSNS., Fasihi M., Khalili S., Dalheimer B.,Gruber G., Traber T., De Caluwe F., Fell H.-J., Breyer C. Global Energy System based on 100% Renewable Energy – Power, Heat, Transport and Desalination Sectors. Study by Lappeenranta University of Technology and Energy Watch Group, Lappeenranta, Berlin, March 2019.ISBN: 978-952-335-339-8ISSN-L: 2243-3376ISSN: 2243-3376Lappeenranta University of Technology Research Reports 91. ISSN: 2243-3376 Lappeenranta 2019

14 For example, already existing guarantee of origin schemes: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENA_Green_hydrogen_policy_2020.pdf [last accessed 10 September 2021].

15 Fraunhofer IEE (2021): Neuer Atlas zeigt erstmals die weltweiten Power-to-X-Potenziale. Available at https://www.iee.fraunhofer.de/de/presse-infothek/Presse-Medien/Pressemitteilungen/2021/neuer-atlas-power-to-x-potenziale.html [last accessed 05 August 2021].

CRITERIA FOR RENEWABLE HYDROGEN PRODUCTION

POLITICAL/ ECONOMICAL

- Respect for human rights and anti-corruption standards should be prerequisites for any engagement of Germany, Europe and other donor countries in the field of hydrogen.
- Forced resettlement or illegal land grabbing must be excluded.
- Stable power supply should always have priority.
- Importing governments should conduct a cost analysis before setting up agreements. Costs, including externalities such as emissions produced by transporting renewable hydrogen from A to B, should not exceed a certain amount and be in line with full decarbonisation plans.
- Governments must ensure risk curtailment related to developing new RE capacities. Therefore, new debt of exporting countries to finance large-scale projects (especially RE capacities) must not exceed a certain amount.
- International investments to develop hydrogen production should only be considered if renewable energy represents the predominant form of generation in a country's electricity mix, or strategies are in place to achieve very high shares of RE in the coming years.
- Large-scale hydrogen production can only begin once the electricity mix of the country in question repeatedly reaches a greenhouse gas intensity below 150-200 grams of CO2/kwh.

PROJECT DEVELOPMENT

- Companies in the hydrogen economy should review their entire value chain and conduct both environmental impact assessments for production facilities and human rights risk analyses.
- Local authorities and civil society stakeholders as well as affected people on the ground should be involved in the planning, implementation and monitoring of projects, if possible, also financially. For the various forms of participation, it will be fundamental to invest in appropriate capacity building for local stakeholders, to establish transparent mechanisms for complaints and to create formats in which citizens can actively participate in decision-making.
- Existing economic players (specific investments in and promotion of local enterprises) should be strengthened, and new competencies built up (promotion of training and innovation programmes). Possibly, a quota of participating local companies should be agreed.
- Hydrogen projects should evidently contribute to overcoming energy poverty, e.g. by making parts of the additional RE capacities used also accessible to local population.
- Only additionally developed RE capacities should be used for electrolysis and desalination. In the event of conflicts of objectives, the expansion of renewable drinking water to desalination always has priority.

RECOMMENDATIONS

To ensure that renewable hydrogen is developed justly and that national development targets are not jeopardised by large-scale hydrogen production, governments should include a set of sustainability, political and economic criteria for evaluation as well as standards.

In addition, the following recommendations may guide policy-making for renewable hydrogen production:

1 To achieve the full decarbonisation of our energy system, governments must establish a clear focus on renewable hydrogen. This includes limiting the use of hydrogen applications to sectors with no alternatives. Electrification of end-use sectors should be given priority when possible. This way, governments can ensure hydrogen demand can be supplied through renewable energy sources.

2 Hydrogen use, especially in the Global North, should only be considered where electrification will not be possible in the longer-term, in order to keep global demand as low as possible.

3 As a prerequisite for sustainable decarbonisation, every hydrogen strategy should be embedded in a broader energy transition strategy that should focus on maximising energy savings, RE expansion and achieving 100% energy access, before considering increased hydrogen production.

4 To discourage fossil hydrogen production and improve competitiveness of renewable hydrogen, a strict and increasing carbon price should be established.

5 Hydrogen imports, where necessary, should come from surrounding regions where low carbon transport options are available. Import strategies should not include long-distance hydrogen imports since they require fossil heavy transport options like shipping which will most likely be too expensive. The EU should thus expect hydrogen imports from the European region and neighbouring states. However, imports of hydrogen derivates (e.g. Ammonia) might be feasible from remote regions as well.

6 Hydrogen production must always be based on strict sustainability and social standards including respect for human rights, local value creation and prioritisation of energy access, conducting environmental impact assessments and cost analysis amongst others. Certification schemes and standards should additionally be established.

7 Hydrogen production in the Global South must not jeopardise national development efforts and should contribute to achieving national implementation of the 17 Sustainable Development Goals (SDGs). This includes eradicating energy poverty and supporting transformation pathways to phase out of fossil fuels, particularly coal.

8 Partnerships with countries in the Global South should focus on RE deployment, production and local use of hydrogen first. Export strategies should focus on hydrogen derivates which create higher local benefits and can be economically transported.

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